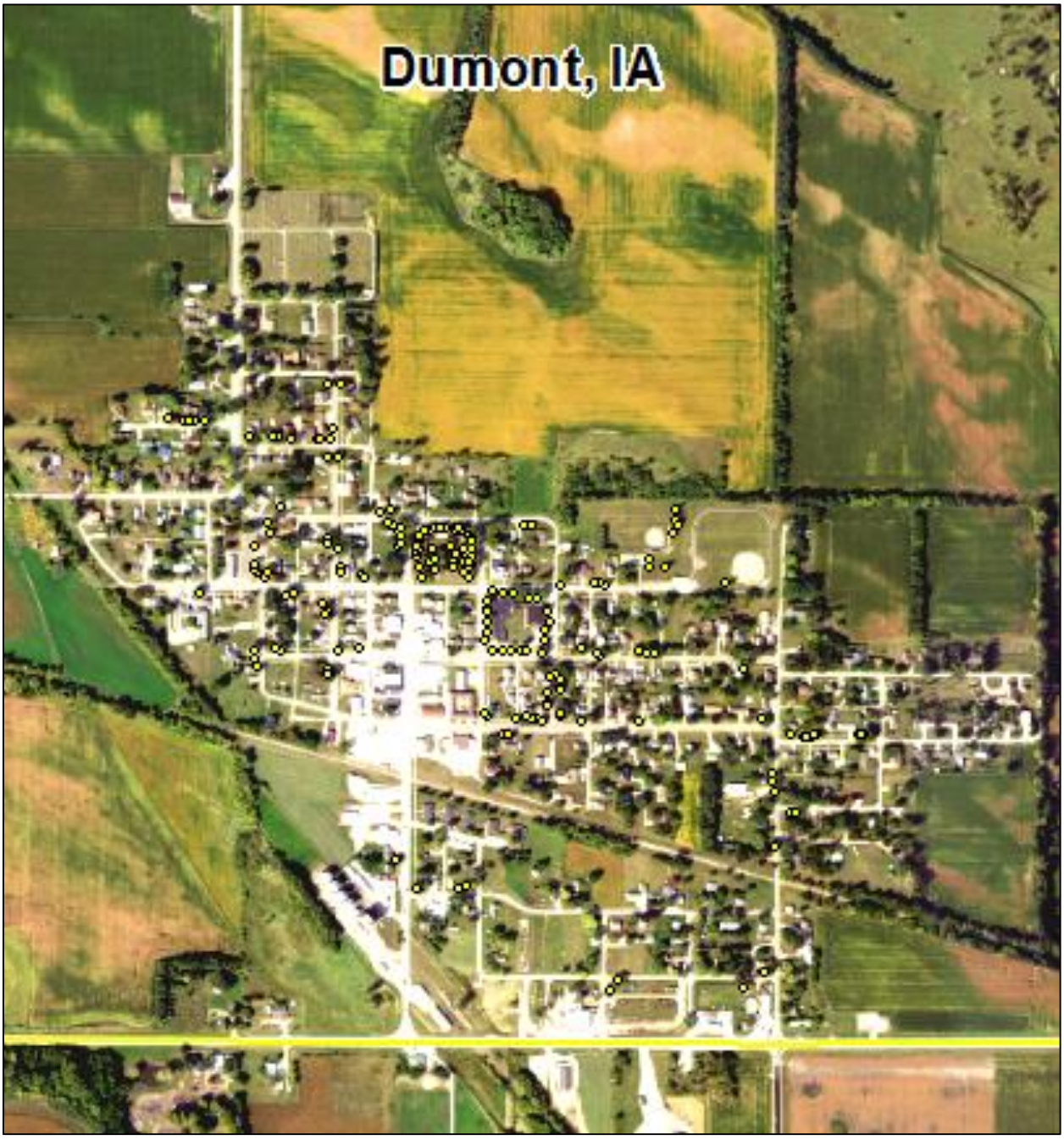
Dumont, IA



2020 Urban Forest Management Plan
Prepared by Iowa Department
of Natural Resources

Table of Contents

Executive Summary

Overview

This plan was developed to assist the City of Dumont with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 13% of Dumont's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2019, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street and park trees. Below are some key findings of the 813 trees inventoried.

- Dumont's trees provide $37,922 of benefits annually, an average of $200 a tree
- There are over 26 species of trees
- The top three genera are: Maple 36%, N. White Cedar 14%, and Ash 17%
- 45% of trees are in need of some type of management
- 11 trees are recommended for removal

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.

- Begin planting a diverse mix of new trees wherever space allows following "right tree, right place" principles
- Of the 11 trees needing removal, 6 trees should be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly

Introduction

This plan was developed to assist Dumont with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the anticipated arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal or treatment and replacement planting. With proper planning and management of the current canopy in Dumont, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Dumont' infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Dumont and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Dumont's urban forestry goals.

Inventory

In 2019, a tree inventory was conducted that included 100% of the city owned trees on both streets and parks. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results

The data collected for the 189 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management as part of the i-Tree suite. The following are results from the i-Tree STREETS analysis. Fin

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Dumont's trees reduce energy related costs by approximately $9,646 annually (Appendix A, Table 1). These savings are both in Electricity (45.6 MWh) and in Natural Gas (3,465 Therms).

Annual Stormwater Benefits

Dumont's trees intercept about 582,273 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $15,780 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Dumont, it is estimated that trees remove 555 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $1,509 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Dumont, trees sequester about 171,600 lbs of carbon a year with an associated value of $1,287 (Appendix A, Table 5). In addition, the trees store 2,082,081 lbs of carbon, with a yearly benefit of $15,616 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Dumont receives $9,700 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STREETS analysis, Dumont's trees provide $37,922 of benefits annually. Benefits of individual trees vary based on size, species, health and location, but on average each of the 189 trees in Dumont provide approximately $200 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Dumont has 26 different tree species along city streets and parks (Appendix A, Figure 1).
The distribution of trees by genera is as follows:

Maple	68	36%
Northern White Cedar	27	14%

Ash	24	13%
Apple (Crab)	16	8%

Age Class

Most of Dumont's trees (68%) are larger than 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Dumont's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Dumont indicate that 95% of the trees are in good health, with only 5% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 91% of Dumont's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3).

Management Needs

The following outlines the specific management needs of the street and park trees by number of trees and percent of canopy (Appendix B, Figure 3).

Needs	No. trees
Crown Cleaning	28
Crown Raising	13
Tree Staking	9
Tree Removal	11
Crown Reduction	24

Canopy Cover

The total canopy with both private and public trees is 10%, 109 acres. The canopy cover included in the Dumont inventory includes approximately 5 acres (Appendix A, Figure 4).

Recommendations

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

<u>Hazardous trees</u>

Dumont had no critical concern trees that need immediate removal at the time of inspection.

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be

addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Dumont.

It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 20% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with maple (36%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan with <u>No Additional Funding</u>

Year 1

- Removal: 11 trees indicated for removal
- Pruning/Trimming: 34 trees flagged as needing “immediate” cleaning, reduction, raising, etc.
- Planting and Replacement: Plant 5 new trees in open spots

Year 2

- Pruning/Trimming: 41 remaining trees flagged as needing “routine” cleaning, reduction, raising, etc.
- Planting and Replacement: Plant 5 new trees in open spots
- Young Tree Pruning & Maintenance

Year 3

- Planting and Replacement: Plant 5 new trees in open spots
- Young Tree Pruning & Maintenance

Year 4

- Planting and Replacement: Plant 5 new trees in open spots
- Young Tree Pruning & Maintenance

Year 5

Planting and Replacement: Plant 5 new trees in open spots
Young Tree Pruning & Maintenance
Pruning/Trimming: Begin routine maintenance of 1/3 of city trees every other year

Year 6
Planting and Replacement: Plant 5 new trees in open spots
Young Tree Pruning & Maintenance

Emerald Ash Borer Plan

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:

- emerald ash borer
- firewood of all hardwood species (for example ash, oak, maple and hickory)
- nursery stock and green lumber of ash
- any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your

county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml. Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement
As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance. The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work
While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

Monitoring
It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees
It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB if preventative treatments are not being used.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Annual Energy Benefits of Public Trees

4/9/2020

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	8.2	624	1,191.1	1,167	1,791	(N/A)	16.9	18.6	55.98
Silver maple	10.0	756	1,327.3	1,301	2,057	(N/A)	14.8	21.3	73.47
Northern white cedar	4.8	365	639.7	627	992	(N/A)	14.3	10.3	36.75
Green ash	7.8	591	1,061.8	1,041	1,632	(N/A)	12.7	16.9	68.00
Apple	1.5	117	235.3	231	348	(N/A)	8.5	3.6	21.73
Northern hackberry	2.2	163	312.4	306	469	(N/A)	3.7	4.9	67.06
Northern red oak	0.6	48	91.9	90	138	(N/A)	3.2	1.4	23.02
Red maple	1.1	86	136.7	134	220	(N/A)	2.6	2.3	44.07
American basswood	0.7	55	104.0	102	157	(N/A)	2.6	1.6	31.33
Black walnut	1.4	108	199.1	195	303	(N/A)	2.1	3.1	75.84
Blue spruce	0.5	39	60.7	60	98	(N/A)	2.1	1.0	24.51
Eastern white pine	0.5	36	63.6	62	99	(N/A)	2.1	1.0	24.66
Pin oak	0.9	72	130.5	128	199	(N/A)	1.6	2.1	66.47
Mountain ash	0.4	34	62.2	61	94	(N/A)	1.6	1.0	31.49
Honeylocust	1.1	83	142.2	139	223	(N/A)	1.6	2.3	74.28
American elm	1.1	84	150.5	147	231	(N/A)	1.6	2.4	76.99
Ohio buckeye	0.9	69	134.4	132	200	(N/A)	1.6	2.1	66.79
Sugar maple	0.6	48	88.4	87	135	(N/A)	1.1	1.4	67.52
Pear	0.3	21	44.5	44	64	(N/A)	1.1	0.7	32.17
Norway spruce	0.0	1	1.3	1	2	(N/A)	1.1	0.0	0.93
Black maple	0.3	22	39.9	39	61	(N/A)	0.5	0.6	60.68
Black cherry	0.2	15	31.6	31	46	(N/A)	0.5	0.5	46.14
Mulberry	0.2	15	31.6	31	46	(N/A)	0.5	0.5	46.14
Eastern red cedar	0.0	0	0.7	1	1	(N/A)	0.5	0.0	0.93
River birch	0.1	8	16.9	17	24	(N/A)	0.5	0.3	24.47
Spruce	0.1	4	9.5	9	14	(N/A)	0.5	0.1	13.58
Total	45.6	3,465	6,307.8	6,182	9,646	(N/A)	100.0	100.0	51.04

Table 2: Annual Stormwater Benefits

Annual Stormwater Benefits of Public Trees

4/9/2020

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	78,408	2,125	(N/A)	16.9	13.5	66.40
Silver maple	159,905	4,333	(N/A)	14.8	27.5	154.76
Northern white cedar	116,148	3,148	(N/A)	14.3	19.9	116.58
Green ash	93,478	2,533	(N/A)	12.7	16.1	105.55
Apple	5,966	162	(N/A)	8.5	1.0	10.11
Northern hackberry	17,204	466	(N/A)	3.7	3.0	66.60
Northern red oak	5,173	140	(N/A)	3.2	0.9	23.37
Red maple	7,041	191	(N/A)	2.6	1.2	38.16
American basswood	4,742	129	(N/A)	2.6	0.8	25.70
Black walnut	19,062	517	(N/A)	2.1	3.3	129.15
Blue spruce	6,177	167	(N/A)	2.1	1.1	41.85
Eastern white pine	8,073	219	(N/A)	2.1	1.4	54.69
Pin oak	9,578	260	(N/A)	1.6	1.6	86.52
Mountain ash	1,598	43	(N/A)	1.6	0.3	14.43
Honeylocust	14,054	381	(N/A)	1.6	2.4	126.96
American elm	10,110	274	(N/A)	1.6	1.7	91.32
Ohio buckeye	10,008	271	(N/A)	1.6	1.7	90.41
Sugar maple	7,592	206	(N/A)	1.1	1.3	102.86
Pear	1,439	39	(N/A)	1.1	0.2	19.49
Norway spruce	97	3	(N/A)	1.1	0.0	1.32
Black maple	2,867	78	(N/A)	0.5	0.5	77.70
Black cherry	1,174	32	(N/A)	0.5	0.2	31.82
Mulberry	1,174	32	(N/A)	0.5	0.2	31.82
Eastern red cedar	24	1	(N/A)	0.5	0.0	0.66
River birch	586	16	(N/A)	0.5	0.1	15.88
Spruce	596	16	(N/A)	0.5	0.1	16.14
Citywide total	582,273	15,780	(N/A)	100.0	100.0	83.49

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

4/9/2020

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2								
Norway maple	16.2	2.8	7.9	0.7	87	39.9	5.8	5.5	37.3	247	-3.8	-14	112.3	320	(N/A)	16.9	10.01
Silver maple	30.5	5.2	14.7	1.4	164	47.1	6.9	6.6	45.1	294	-16.0	-60	141.3	398	(N/A)	14.8	14.21
Northern white cedar	14.2	2.8	11.2	1.7	92	22.8	3.3	3.2	21.8	142	-69.9	-262	11.2	-27	(N/A)	14.3	-1.02
Green ash	13.7	2.2	6.3	0.6	72	37.2	5.4	5.2	35.3	232	0.0	0	105.9	304	(N/A)	12.7	12.66
Apple	1.6	0.3	0.8	0.1	9	7.6	1.1	1.0	7.0	47	0.0	0	19.4	55	(N/A)	8.5	3.45
Northern hackberry	2.2	0.4	1.2	0.1	12	10.4	1.5	1.4	9.8	65	0.0	0	27.1	77	(N/A)	3.7	11.01
Northern red oak	1.0	0.2	0.5	0.0	5	3.1	0.4	0.4	2.9	19	-1.4	-5	7.1	19	(N/A)	3.2	3.20
Red maple	1.4	0.2	0.7	0.1	7	5.3	0.8	0.7	5.2	33	-0.5	-2	13.8	39	(N/A)	2.6	7.73
American basswood	0.4	0.1	0.2	0.0	2	3.5	0.5	0.5	3.3	22	-0.4	-2	8.1	22	(N/A)	2.6	4.47
Black walnut	2.6	0.4	1.2	0.1	14	6.8	1.0	0.9	6.5	43	0.0	0	19.6	56	(N/A)	2.1	14.12
Blue spruce	0.8	0.2	0.6	0.1	5	2.3	0.3	0.3	2.3	15	-2.2	-8	4.8	12	(N/A)	2.1	2.89
Eastern white pine	0.9	0.2	0.8	0.1	6	2.3	0.3	0.3	2.2	14	-3.5	-13	3.6	7	(N/A)	2.1	1.80
Pin oak	1.6	0.3	0.8	0.1	9	4.5	0.7	0.6	4.3	28	-2.9	-11	9.8	26	(N/A)	1.6	8.54
Mountain ash	0.5	0.1	0.2	0.0	2	2.1	0.3	0.3	2.0	13	0.0	0	5.5	16	(N/A)	1.6	5.22
Honeylocust	2.8	0.5	1.3	0.1	15	5.2	0.8	0.7	5.0	32	-2.3	-9	14.0	39	(N/A)	1.6	12.87
American elm	2.0	0.3	1.0	0.1	11	5.3	0.8	0.7	5.0	33	0.0	0	15.1	43	(N/A)	1.6	14.48
Ohio buckeye	2.2	0.4	1.1	0.1	12	4.4	0.6	0.6	4.1	27	-0.5	-2	13.0	37	(N/A)	1.6	12.44
Sugar maple	1.0	0.2	0.5	0.0	5	3.1	0.4	0.4	2.9	19	-0.8	-3	7.7	22	(N/A)	1.1	10.75
Pear	0.5	0.1	0.2	0.0	3	1.4	0.2	0.2	1.2	8	0.0	0	3.8	11	(N/A)	1.1	5.45
Norway spruce	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	1.1	0.05
Black maple	0.7	0.1	0.3	0.0	4	1.4	0.2	0.2	1.3	8	-0.2	-1	4.0	12	(N/A)	0.5	11.54
Black cherry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8	(N/A)	0.5	8.35
Mulberry	0.4	0.1	0.2	0.0	2	1.0	0.1	0.1	0.9	6	0.0	0	2.9	8	(N/A)	0.5	8.35
Eastern red cedar	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	(N/A)	0.5	0.09
River birch	0.1	0.0	0.0	0.0	0	0.5	0.1	0.1	0.5	3	0.0	0	1.2	3	(N/A)	0.5	3.47
Spruce	0.1	0.0	0.1	0.0	0	0.3	0.0	0.0	0.3	2	-0.2	-1	0.6	1	(N/A)	0.5	1.48
Citywide total	97.7	16.9	52.1	5.6	543	218.3	31.8	30.3	206.8	1,359	-104.7	-393	554.9	1,509	(N/A)	100.0	7.98

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

4/9/2020

Species	Total Stored CO2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	266,306	1,997	(N/A)	16.9	12.8	62.42
Silver maple	749,688	5,623	(N/A)	14.8	36.0	200.81
Northern white cedar	181,500	1,361	(N/A)	14.3	8.7	50.42
Green ash	459,562	3,447	(N/A)	12.7	22.1	143.61
Apple	25,958	195	(N/A)	8.5	1.2	12.17
Northern hackberry	30,437	228	(N/A)	3.7	1.5	32.61
Northern red oak	18,510	139	(N/A)	3.2	0.9	23.14
Red maple	15,597	117	(N/A)	2.6	0.7	23.40
American basswood	14,887	112	(N/A)	2.6	0.7	22.33
Black walnut	86,287	647	(N/A)	2.1	4.1	161.79
Blue spruce	4,473	34	(N/A)	2.1	0.2	8.39
Eastern white pine	8,112	61	(N/A)	2.1	0.4	15.21
Pin oak	38,696	290	(N/A)	1.6	1.9	96.74
Mountain ash	6,982	52	(N/A)	1.6	0.3	17.46
Honeylocust	36,735	276	(N/A)	1.6	1.8	91.84
American elm	42,839	321	(N/A)	1.6	2.1	107.10
Ohio buckeye	36,506	274	(N/A)	1.6	1.8	91.26
Sugar maple	28,560	214	(N/A)	1.1	1.4	107.10
Pear	7,651	57	(N/A)	1.1	0.4	28.69
Norway spruce	5	0	(N/A)	1.1	0.0	0.02
Black maple	7,945	60	(N/A)	0.5	0.4	59.59
Black cherry	6,743	51	(N/A)	0.5	0.3	50.57
Mulberry	6,743	51	(N/A)	0.5	0.3	50.57
Eastern red cedar	3	0	(N/A)	0.5	0.0	0.02
River birch	1,101	8	(N/A)	0.5	0.1	8.26
Spruce	257	2	(N/A)	0.5	0.0	1.93
Citywide total	2,082,081	15,616	(N/A)	100.0	100.0	82.62

Table 5: Annual Carbon Sequestered

Annual CO Benefits of Public Trees

4/9/2020

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	11,257	84	-1,278	-87	-10	13,793	103	23,685	178 (N/A)	16.9	13.8	5.55
Silver maple	49,095	368	-3,599	-119	-28	16,715	125	62,092	466 (N/A)	14.8	36.2	16.63
Northern white cedar	1,705	13	-871	-119	-7	8,073	61	8,788	66 (N/A)	14.3	5.1	2.44
Green ash	16,523	124	-2,206	-83	-17	13,071	98	27,305	205 (N/A)	12.7	15.9	8.53
Apple	2,498	19	-125	-21	-1	2,587	19	4,939	37 (N/A)	8.5	2.9	2.32
Northern hackberry	2,470	19	-146	-19	-1	3,608	27	5,912	44 (N/A)	3.7	3.4	6.33
Northern red oak	1,068	8	-89	-8	-1	1,061	8	2,033	15 (N/A)	3.2	1.2	2.54
Red maple	2,098	16	-75	-9	-1	1,909	14	3,923	29 (N/A)	2.6	2.3	5.88
American basswood	1,273	10	-71	-8	-1	1,209	9	2,403	18 (N/A)	2.6	1.4	3.60
Black walnut	3,538	27	-414	-16	-3	2,391	18	5,500	41 (N/A)	2.1	3.2	10.31
Blue spruce	363	3	-21	-8	0	851	6	1,185	9 (N/A)	2.1	0.7	2.22
Eastern white pine	543	4	-39	-9	0	804	6	1,299	10 (N/A)	2.1	0.8	2.44
Pin oak	3,863	29	-186	-10	-1	1,581	12	5,249	39 (N/A)	1.6	3.1	13.12
Mountain ash	649	5	-34	-5	0	741	6	1,352	10 (N/A)	1.6	0.8	3.38
Honeylocust	4,457	33	-176	-8	-1	1,844	14	6,117	46 (N/A)	1.6	3.6	15.29
American elm	1,339	10	-206	-11	-2	1,846	14	2,969	22 (N/A)	1.6	1.7	7.42
Ohio buckeye	470	4	-175	-11	-1	1,517	11	1,801	14 (N/A)	1.6	1.0	4.50
Sugar maple	1,515	11	-137	-7	-1	1,070	8	2,441	18 (N/A)	1.1	1.4	9.15
Pear	114	1	-37	-5	0	459	3	531	4 (N/A)	1.1	0.3	1.99
Norway spruce	7	0	0	0	0	12	0	19	0 (N/A)	1.1	0.0	0.07
Black maple	0	0	-38	-3	0	477	4	436	3 (N/A)	0.5	0.3	3.27
Black cherry	478	4	-32	-3	0	335	3	778	6 (N/A)	0.5	0.5	5.84
Mulberry	0	0	-32	-4	0	335	3	299	2 (N/A)	0.5	0.2	2.24
Eastern red cedar	1	0	0	0	0	6	0	6	0 (N/A)	0.5	0.0	0.05
River birch	224	2	-5	-1	0	176	1	393	3 (N/A)	0.5	0.2	2.95
Spruce	53	0	-1	-1	0	94	1	145	1 (N/A)	0.5	0.1	1.08
Citywide total	105,602	792	-9,994	-574	-79	76,566	574	171,600	1,287 (N/A)	100.0	100.0	6.81

Table 6: Annual Social and Aesthetic Benefits

Annual Aesthetic/Other Benefits of Public Trees

4/9/2020

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Norway maple	1,061	(N/A)	16.9	10.9	33.16
Silver maple	3,515	(N/A)	14.8	36.2	125.55
Northern white cedar	314	(N/A)	14.3	3.2	11.64
Green ash	1,308	(N/A)	12.7	13.5	54.52
Apple	144	(N/A)	8.5	1.5	8.99
Northern hackberry	364	(N/A)	3.7	3.8	52.06
Northern red oak	90	(N/A)	3.2	0.9	15.08
Red maple	293	(N/A)	2.6	3.0	58.68
American basswood	115	(N/A)	2.6	1.2	23.09
Black walnut	257	(N/A)	2.1	2.7	64.37
Blue spruce	101	(N/A)	2.1	1.0	25.23
Eastern white pine	142	(N/A)	2.1	1.5	35.48
Pin oak	316	(N/A)	1.6	3.3	105.29
Mountain ash	37	(N/A)	1.6	0.4	12.46
Honeylocust	1,167	(N/A)	1.6	12.0	388.90
American elm	184	(N/A)	1.6	1.9	61.44
Ohio buckeye	43	(N/A)	1.6	0.4	14.35
Sugar maple	153	(N/A)	1.1	1.6	76.42
Pear	6	(N/A)	1.1	0.1	3.20
Norway spruce	12	(N/A)	1.1	0.1	5.76
Black maple	0	(N/A)	0.5	0.0	0.00
Black cherry	29	(N/A)	0.5	0.3	28.80
Mulberry	0	(N/A)	0.5	0.0	0.00
Eastern red cedar	4	(N/A)	0.5	0.0	4.27
River birch	26	(N/A)	0.5	0.3	26.22
Spruce	15	(N/A)	0.5	0.2	15.42
Citywide total	9,700	(N/A)	100.0	100.0	51.32

Table 7: Summary of Benefits in Dollars

Total Annual Benefits of Public Trees by Species ($)

4/9/2020

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Norway maple	1,791	178	320	2,125	1,061	5,475	(N/A)	14.4
Silver maple	2,057	466	398	4,333	3,515	10,770	(N/A)	28.4
Northern white cedar	992	66	-27	3,148	314	4,493	(N/A)	11.8
Green ash	1,632	205	304	2,533	1,308	5,982	(N/A)	15.8
Apple	348	37	55	162	144	745	(N/A)	2.0
Northern hackberry	469	44	77	466	364	1,421	(N/A)	3.7
Northern red oak	138	15	19	140	90	403	(N/A)	1.1
Red maple	220	29	39	191	293	773	(N/A)	2.0
American basswood	157	18	22	129	115	441	(N/A)	1.2
Black walnut	303	41	56	517	257	1,175	(N/A)	3.1
Blue spruce	98	9	12	167	101	387	(N/A)	1.0
Eastern white pine	99	10	7	219	142	476	(N/A)	1.3
Pin oak	199	39	26	260	316	840	(N/A)	2.2
Mountain ash	94	10	16	43	37	201	(N/A)	0.5
Honeylocust	223	46	39	381	1,167	1,855	(N/A)	4.9
American elm	231	22	43	274	184	755	(N/A)	2.0
Ohio buckeye	200	14	37	271	43	565	(N/A)	1.5
Sugar maple	135	18	22	206	153	533	(N/A)	1.4
Pear	64	4	11	39	6	125	(N/A)	0.3
Norway spruce	2	0	0	3	12	16	(N/A)	0.0
Black maple	61	3	12	78	0	153	(N/A)	0.4
Black cherry	46	6	8	32	29	121	(N/A)	0.3
Mulberry	46	2	8	32	0	89	(N/A)	0.2
Eastern red cedar	1	0	0	1	4	6	(N/A)	0.0
River birch	24	3	3	16	26	73	(N/A)	0.2
Spruce	14	1	1	16	15	48	(N/A)	0.1
Citywide Total	9,646	1,287	1,509	15,780	9,700	37,922	(N/A)	100.0

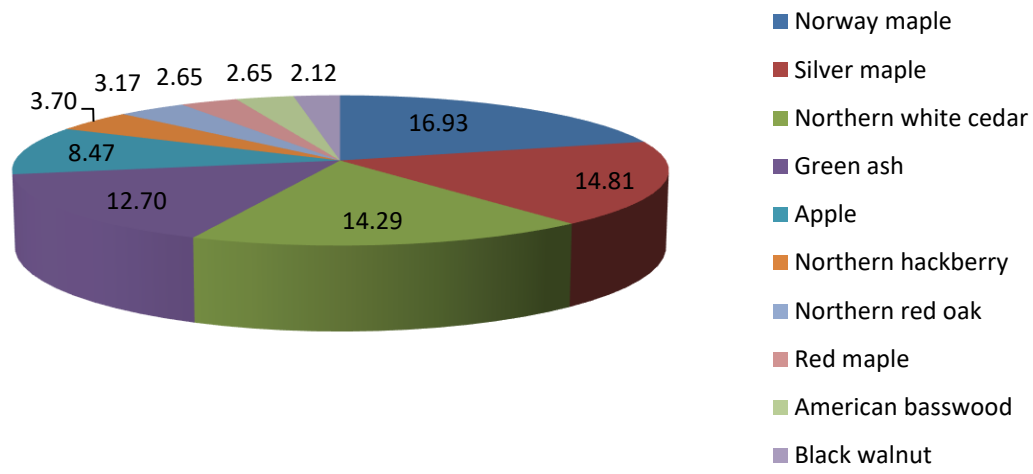

Figure 1: Species Distribution

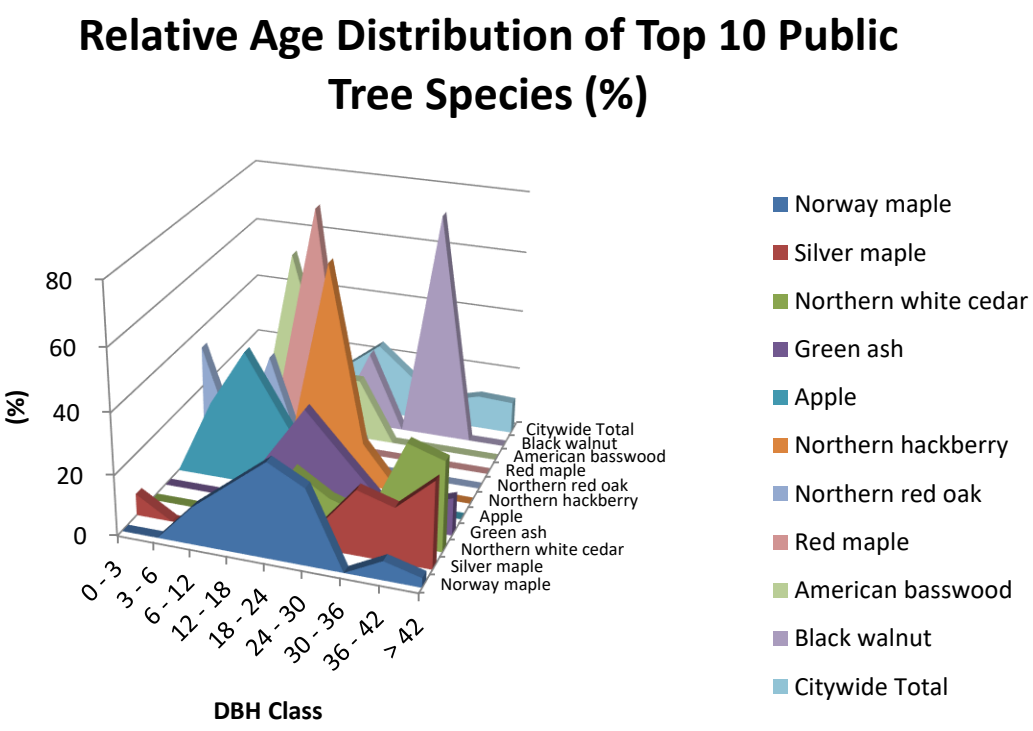

Figure 2: Relative Age Class

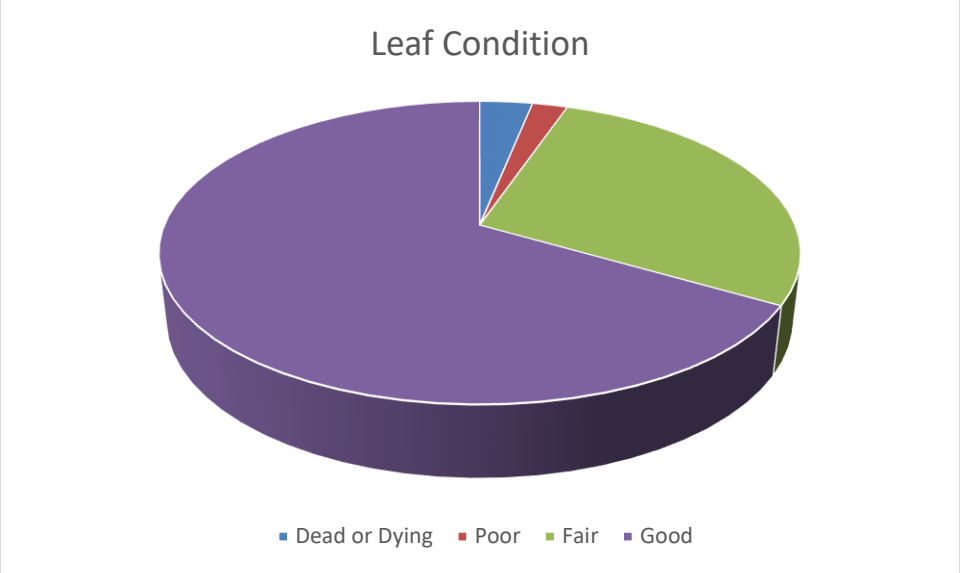

Figure 3: Foliage Condition

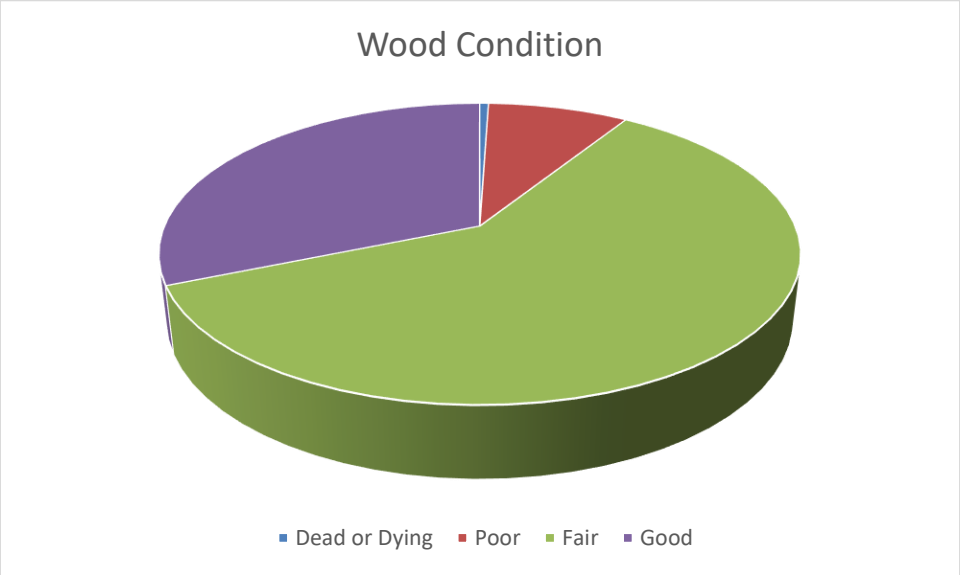

Figure 4: Wood Condition

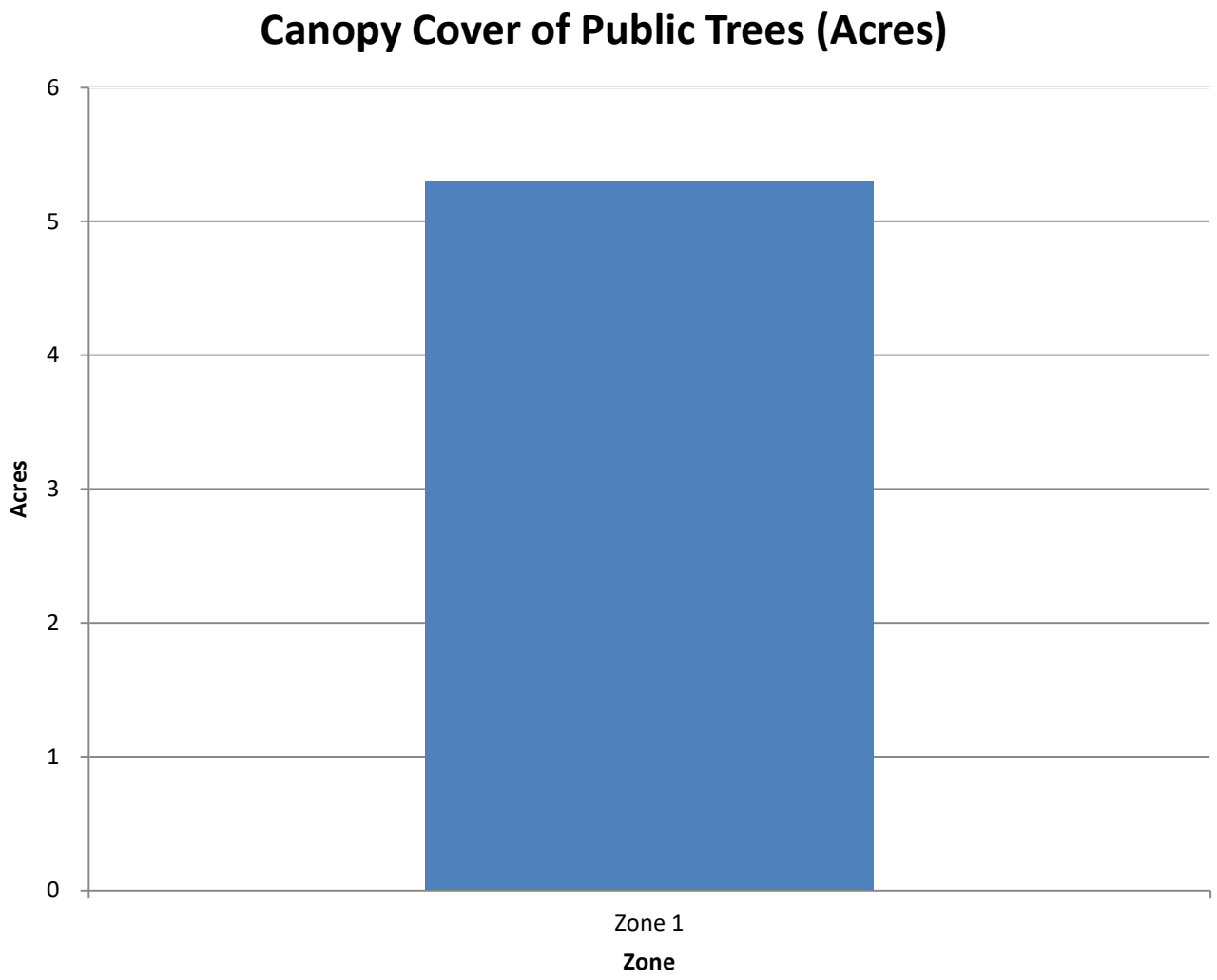

Figure 5: Canopy Cover in Acres

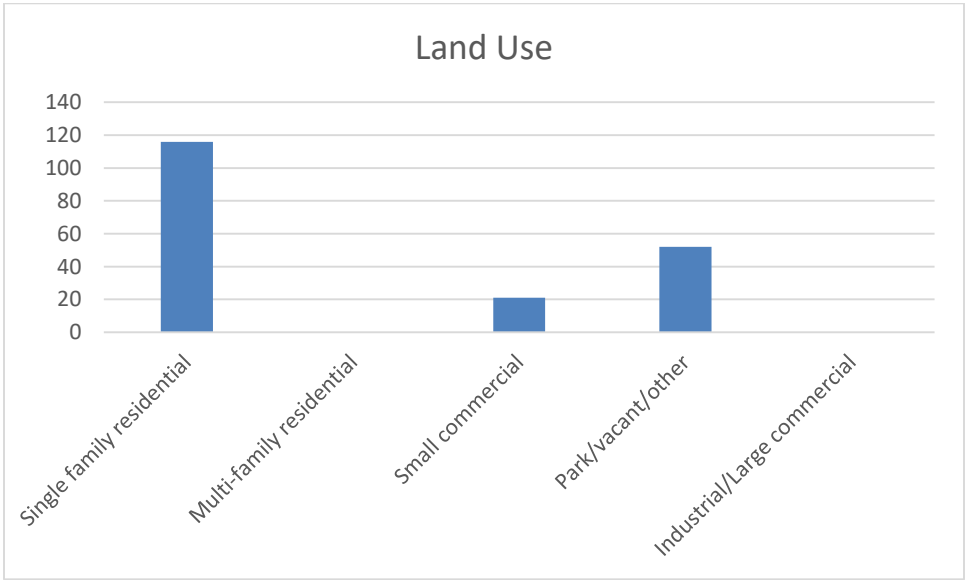

Figure 6: Land Use of city/park trees

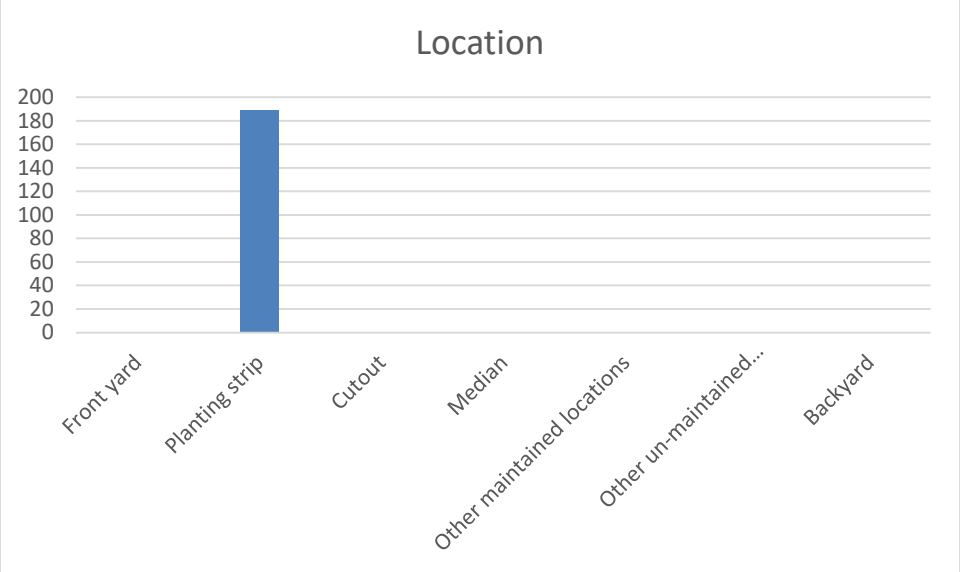

Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

None

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

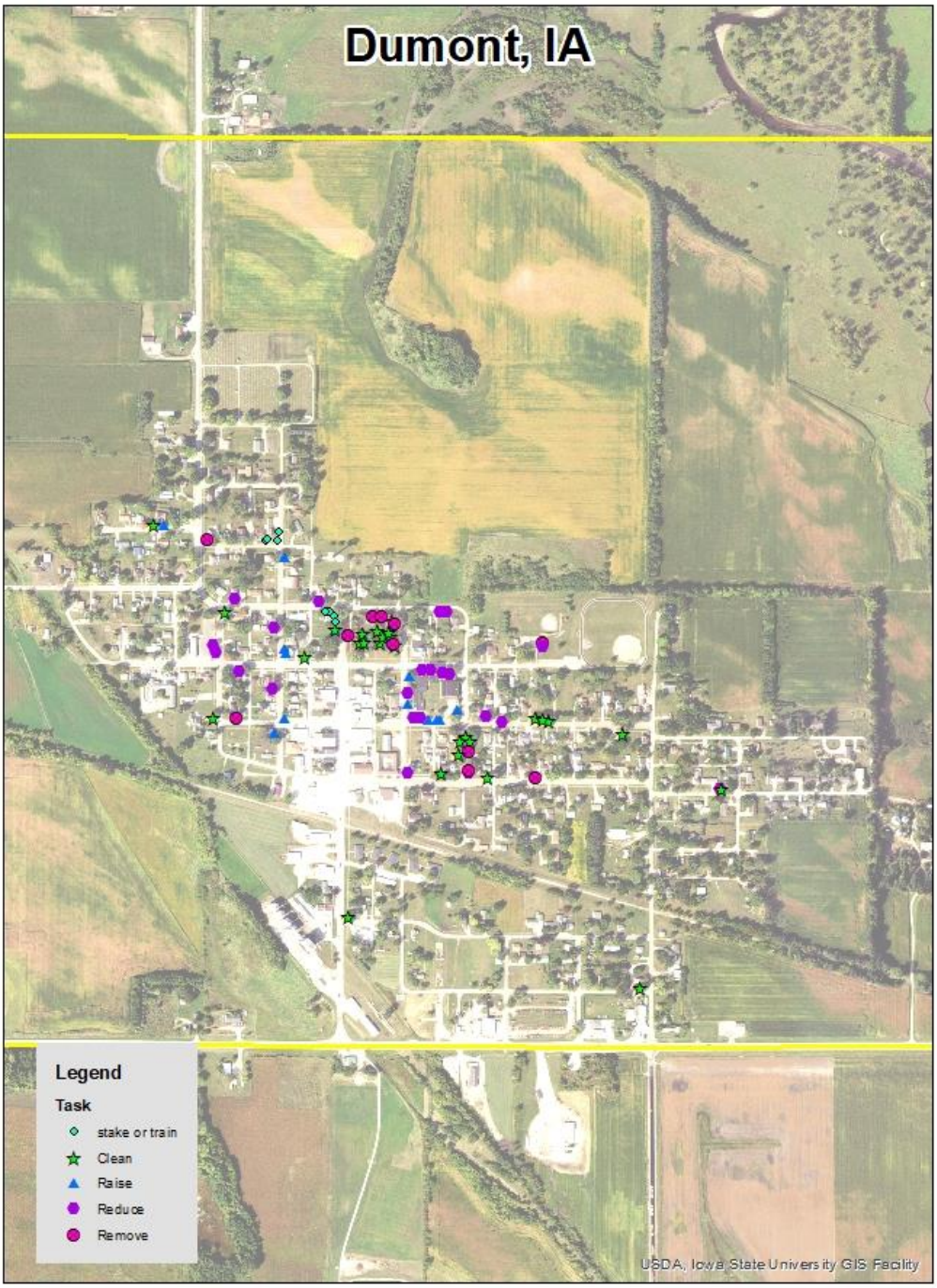

Figure 5: Maintenance Tasks *City ownership of the trees recommended for removal should be verified prior to any removal*

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